**DECLARATION**

I, Kyo Joon SEO of SUNYOUNG INT'L PATENT & LAW FIRM, 6th Fl., Hyun Juk Bldg., 832-41, Yeoksam-dong, Gangnam-gu, Seoul 135-080, Korea

do hereby declare that:

1) I am conversant with the English and Korean languages and am a competent translator therebetween;

2) To the best of my knowledge and belief, the attached is a true and correct translation of the priority applications No. 10-2003-0045539 for the U.S Patent Application No. 10/527,755

Signed this 20th day of November, 2008

Kyo Joon SEO

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## [ABSTRACT]

The present disclosure relates to a vibrator, and more particularly, to a vibrator structure in which elastic units are disposed on the top and bottom surfaces of a weight to increase the outer diameter of the weight so that a vibration force of the weight can be increased and the size of the vibrator can be reduced. The vibrator structure includes: upper and lower cases coupled to each other and facing each other; a magnetic force generating unit disposed on at least one surface of the upper and lower cases; a magnet facing the magnetic force generating unit and applying an attractive or repulsive force to the magnetic force generating unit; a weight to which the magnet is integrally coupled, the weight increasing a vibration force while being moved upward and downward; an elastic unit disposed at at least one of top and bottom surfaces of the weight so that the weight is elastically supported on an end of the elastic unit; and a fixing member configured to fix the other end of the elastic unit to the upper case or the lower case. Elastic units may be disposed at the top and bottom sides of the weight to support the weight that is configured to be vibrated, so as to increase the outer diameter of the weight and the vibration force of the weight. In addition, although the outer diameter of the vibrator is reduced, the vibration force of the vibrator can be increased as compared with the vibration force of a related-art vibrator.


**[REPRESENTATIVE DRAWING]**

Fig. 2

## [SPECIFICATION]

## [TITLE OF THE INVENTION]

**VIBRATOR STRUCTURE**

## [BRIEF DESCRIPTION OF THE DRAWINGS]

Fig. 1 is a sectional view showing a conventional vibrator.

Fig. 2 is a schematic sectional view showing a vibrator according to an embodiment.

Fig. 3 is a perspective view showing an elastic unit according to an embodiment.

Fig. 4 is a schematic sectional view showing a vibrator according to a second embodiment.

<DESCRIPTION OF THE SYMBOLS IN MAIN PORTIONS OF THE DRAWINGS>

| | |
|---|---|
| 110: upper case | 120: lower case |
| 130: magnetic force generating unit | 140: magnet |
| 150: weight | 151: magnet mounting groove |
| 153: elastic unit insert groove | 160: elastic unit |
| 161: circular ring | 163: support leg |
| 170: fixing member | 171: fixing end |
| 173: recess | W: weight extension part |

## [DETAILED DESCRIPTION OF THE PRESENT INVENTION]

## [OBJECT OF THE PRESENT INVENTION]

## [FIELD OF THE INVENTION AND DESCRIPTION OF THE RELATED ART]

The present disclosure relates to a vibrator, and more particularly, to a vibrator structure in which elastic units are disposed on the top and bottom surfaces of a weight

to increase the outer diameter of the weight so that a vibration force of the weight can be increased and the size of the vibrator can be reduced.

Generally, a vibrator is included in a personal information communication device such as a mobile communication terminal (e.g., a beeper and a cellular phone) to inform a user of a message receiving state by vibration.

Fig. 1 is a schematic view illustrating a vibrator of the related art. The vibrator includes a stator and a mover.

The stator includes a lower case 20. A circuit substrate is mounted on the lower case 20 for connecting a circuit. A coil 30 is attached to a top center portion of the circuit substrate. A coupling member 70 is coupled to the periphery of the coupling member 70 for forming a hollow part having a predetermined height. An upper case 10 is coupled to a top end of the coupling member 70 to face the lower case 20.

The mover includes a plurality of leaf springs 60 disposed at the inner circumference of the coupling member 70 to elastically support a weight 50 in the hollow part, and a magnet 40 is inserted to face the coil 30 disposed under the weight 50.

An operation of the vibrator will now be described.

First, power is supplied to the coil 30 through an additional power connection device 80. Then, a magnetic field is formed at the coil 30, and thus the coil 30 attracts or repulses the magnet 40.

The mover is vertically moved by attractive and repulsive forces between the coil 30 and the magnet 40. That is, the mover vibrates while being supported on the leaf springs 60. However, the above-described vibrator of the related art should be reduced in size so as to be installed in a narrow installation place of a recent high-performance cellular phone including many components. That is, the outer diameter of the vibrator should be reduced. However, in this case, the weight of the vibrator reduces, and thus the vibration force of the vibrator reduces.

In a method proposed to address this problem, the thickness of upper and lower portions of the weight 50 are increased to increase the vibration force of the weight 50.

Although the weight of the weight 50 can be increased by increasing the thickness of the weight 50, the vibration force is not increased but decreased due to a reduced magnetic force because the outer diameter of the magnet 40 reduces.

In another attempt of the related art, the outer diameter of the weight 50 is increased in a circumferential direction without reducing the outer diameter of the magnet 40. However, in this case, the vibration force is also reduced because the length of the leaf spring 60 reduces relatively.

## [TECHNICAL OBJECT OF THE INVENTION]

Embodiments provide a vibrator structure in which elastic units are disposed on the top and bottom surfaces of a weight to support the weight used to increase vibration force.

Embodiments also provide a vibrator structure for increasing the outer diameter of a weight to increase vibration force.

Embodiments also provide a vibrator structure for increasing the vibration force of a vibrator while reducing the outer diameter of the vibrator.

## [CONSTITUTION AND OPERATION OF THE INVENTION]

In one embodiment, a vibrator structure includes: upper and lower cases coupled to each other and facing each other; a magnetic force generating unit disposed on at least one surface of the upper and lower cases; a magnet facing the magnetic force generating unit and applying an attractive or repulsive force to the magnetic force generating unit; a weight to which the magnet is integrally coupled, the weight increasing a vibration force while being moved upward and downward; an elastic unit disposed at at least one of top and bottom surfaces of the weight so that the weight is elastically supported on an end of the elastic unit; and a fixing member configured to fix the other end of the elastic unit to the upper case or the lower case.

The magnetic force generating unit may be disposed only at one surface of the

upper and lower cases, and the magnet may be disposed only at one surface of the weight so as to face the magnetic force generating unit and apply an attractive or repulsive force to the magnetic force generating unit.

The magnetic force generating unit may an electromagnet including a wound coil.

The weight may include; a magnet mounting groove formed in a bottom center portion thereof to a predetermined depth; elastic unit insert grooves formed in upper and bottom surfaces of the weight around the magnet mounting groove for receiving and fixing the end of the elastic unit; and a weight extension part extending outward from the elastic unit insert grooves.

The weight may be formed of a material including tungsten.

The elastic unit may be an axial leaf spring including: a plate-shaped circular ring disposed on an end of the elastic unit for being inserted in the elastic unit insert groove of the weight; and a plurality of support legs extending from the circular ring, each of the support legs extending downward from the circular ring in the center-axis direction of the circular ring along a predetermined whirling curve, ends of the support legs being fixed to the upper case or the lower case by the fixing member.

The number of support legs may be at least three.

The elastic unit may be a conic coil spring.

The fixing member may have a cylindrical shape with an approximately C-shaped section, and the fixing member may include: fixing ends at upper and lower portions to fix the other end of the elastic unit directly to the upper or lower case; and a recess extending inwardly from the fixing ends.

The recess may provide a space in which the weight extension part is moved upward and downward.

The fixing member may be additionally disposed only at a position where the other end of the elastic unit is fixed.

Magnetic force generating units may be respectively disposed at the upper and lower cases, and magnets corresponding to the magnetic force generating units may be

respectively disposed at the top and bottom surfaces of the weight to apply attractive or repulsive forces to the magnetic force generating units.
Only a single magnet may be disposed to penetrate the weight.

The present disclosure will now be described more fully hereinafter with reference to the accompanying drawings, in which preferred embodiments of the invention are shown.

Fig. 2 is a schematic sectional view showing a vibrator according to an embodiment, and Fig. 3 is a perspective view showing an elastic unit according to an embodiment.

Referring to Figs. 2 and 3, the vibrator of the current embodiment includes: an upper case 110; a lower case 120 coupled to the upper case 110 and facing the upper case 110; a magnetic force generating unit 130 disposed on the top surface of the lower case 120; a magnet 140 faces the magnetic force generating unit 130 to form an attractive or repulse force between the magnet 140 and the magnetic force generating unit 130; a weight 150 in which the magnet 140 is integrally disposed so that the weight 150 moves upward and downward to increase vibration force; elastic units 160 disposed at the top and bottom sides of the weight 150 to support the weight 150 elastically; and a fixing member 170 configured to fix ends of the elastic units 160 to the upper case 110 and the lower case 120.

The magnetic force generating unit 130 is an electromagnet including a wound coil.

A magnet mounting groove 151 is formed in a bottom center portion of the weight 150 to a predetermined depth, and elastic unit insert grooves 153 are formed in the top and bottom sides of the weight around the magnet mounting groove 151 so that the other ends of the elastic units 160 can be inserted and fixed. The weight 150 includes an extension part W extending outward from the elastic unit insert grooves 153. The weight 150 may be formed of a material including tungsten.

As shown in Fig. 3, each of the elastic units 160 is an axial leaf spring including a plate-shaped circular ring 160 and a plurality of support legs 163. The circular ring 161 is disposed on an end of the elastic unit 160 for being inserted in the elastic unit insert groove 153 of the weight 150. The support legs 163 extend from the circular ring 161. Each of the support legs 163 extends downward from the circular ring 161 in the center-axis direction of the circular ring 161 along a predetermined whirling curve. Ends of the support legs 163 are fixed to the upper case 110 or the lower case 120 by the fixing member 170.

Approximately, the number of the support legs 163 may be three.

Alternatively, conic coil springs may be used as the elastic units 160. The elastic units 160 may be leaf springs such as circular, rectangular, or pentagonal leaf springs. Approximately, the fixing member 170 has a C-shaped section. Fixing ends 171 are formed on upper and lower portions of the fixing member 170 to fix ends of the elastic units 160 directly to the upper case 110 and the lower case 120. Recess 173 is formed in the fixing member 170 between the fixing ends 171. The recess 173 provides a space in which the weight extension part W can move upward and downward. Fixing members may be individually disposed at positions where ends of the elastic units 160 are fixed, or a cylindrical member having a C-shaped section may be used as the fixing member 170.

An exemplary operation of the vibrator will now be described.

First, a discrete current is applied to the magnetic force generating unit 130 at a frequency of several tens to several hundreds of times per second to form a magnetic field and generate attractive and repulsive forces between the magnetic force generating unit 130 and the magnet 140. Since the attractive and repulsive forces alternate at a frequency of several tens to several hundreds of times per second, the weight 150 to which the magnet 140 is integrally coupled is vertically and continuously vibrated, and the vibration is transmitted to the outside.

Since the elastic units 160 are disposed on the top and bottom sides of the

weight 150, an installation space of the weight 150 can be reduced as compared with the case of a related-art vibrator in which elastic units are disposed at the circumference of a weight. In other words, the outer diameter of the weight 150 can be increased owing to the saved installation space. Therefore, without reducing the size of the magnet 140, the weight of the weight 150 can be increased to increase vibration force.

In the embodiment shown in Fig. 2, the weight extension part W extends from the elastic unit insert grooves 153 of the weight 150, at which ends of the elastic units 160 are inserted and fixed, close to an inner surface of the recess 173 of the fixing member 170. Therefore, according to the embodiment, vibration force can be increased by 1.5 times.

Fig. 4 is a schematic sectional view showing a vibrator according to a second embodiment. Referring to Fig. 4, magnetic force generating units 130 are disposed at upper and lower cases 110 and 120, respectively. Magnets 140 are disposed at the top and bottom sides of a weight 150, respectively. Therefore, vibration force of the vibrator can be increased.

Alternatively, a single magnet may be disposed to penetrate the weight 150.

**[EFFECT OF THE INVENTION]**

As described previously, the elastic units are disposed at the top and bottom sides of the weight to support the weight that is configured to be vibrated, so that the outer diameter of the weight can be increased to increase the vibration force of the weight.

In addition, although the outer diameter of the vibrator is reduced, the vibration force of the vibrator can be increased as compared with the vibration force of a related-art vibrator.

**WHAT IS CLAIMED IS:**

1. A vibrator structure comprising:

upper and lower cases coupled to each other and facing each other;

a magnetic force generating unit disposed on at least one surface of the upper and lower cases;

a magnet facing the magnetic force generating unit and applying an attractive or repulsive force to the magnetic force generating unit;

a weight to which the magnet is integrally coupled, the weight increasing a vibration force while being moved upward and downward;

an elastic unit disposed at at least one of top and bottom surfaces of the weight so that the weight is elastically supported on an end of the elastic unit; and

a fixing member configured to fix the other end of the elastic unit to the upper case or the lower case.

2. The vibrator structure according to claim 1, wherein the magnetic force generating unit is disposed only at one surface of the upper and lower cases, and the magnet is disposed only at one surface of the weight so as to face the magnetic force generating unit and apply an attractive or repulsive force to the magnetic force generating unit.

3. The vibrator structure according to claim 1, wherein the magnetic force generating unit is an electromagnet comprising a wound coil.

4. The vibrator structure according to claim 1, wherein the weight comprises;

a magnet mounting groove formed in a bottom center portion thereof to a predetermined depth;

elastic unit insert grooves formed in upper and bottom surfaces of the weight around the magnet mounting groove for receiving and fixing the end of the elastic unit; and

a weight extension part extending outward from the elastic unit insert grooves.

5. The vibrator structure according to claim 1, wherein the weight is formed of a material comprising tungsten.

6. The vibrator structure according to claim 1, wherein the elastic unit is an axial leaf spring comprising:

a plate-shaped circular ring disposed on an end of the elastic unit for being inserted in the elastic unit insert groove of the weight; and

a plurality of support legs extending from the circular ring, each of the support legs extending downward from the circular ring in the center-axis direction of the circular ring along a predetermined whirling curve, ends of the support legs being fixed to the upper case or the lower case by the fixing member.

7. The vibrator structure according to claim 6, wherein the number of support legs is at least three.

8. The vibrator structure according to claim 1, wherein the elastic unit is a conic coil spring.

9. The vibrator structure according to claim 8, wherein the elastic unit is a circular, rectangular, pentagonal, or hexagonal leaf spring.

10. The vibrator structure according to claim 1, wherein the fixing member has a cylindrical shape with an approximately C-shaped section, and the fixing member

comprises:

fixing ends at upper and lower portions to fix the other end of the elastic unit directly to the upper or lower case; and

a recess extending inwardly from the fixing ends.

11. The vibrator structure according to claim 10, wherein the recess provides a space in which the weight extension part is moved upward and downward.

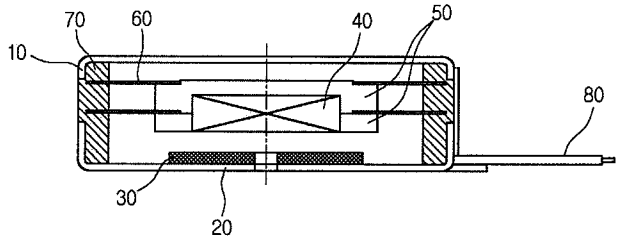
12. The vibrator structure according to claim 1, wherein the fixing member is additionally disposed only at a position where the other end of the elastic unit is fixed.

13. The vibrator structure according to claim 1, wherein magnetic force generating units are respectively disposed at the upper and lower cases, and magnets corresponding to the magnetic force generating units are respectively disposed at the top and bottom surfaces of the weight to apply attractive or repulsive forces to the magnetic force generating units.

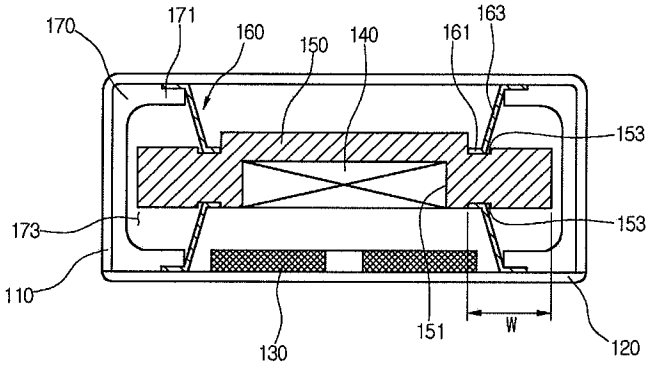
14. The vibrator structure according to claim 13, wherein only a single magnet is disposed to penetrate the weight.

【Figure】

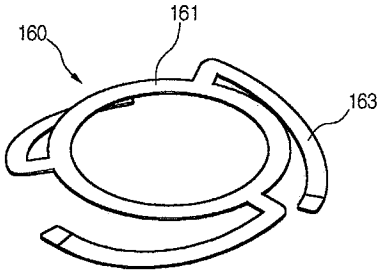
【Fig. 1】




【Fig. 2】




【Fig. 3】




【Fig. 4】